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13. ABSTRACT *(Maximum 200 words)*

The AASERT grant was initially funded 7/1/95 and a Ph.D. student (Anne Le) was hired and started her studies towards a Ph.D. degree working on the problem of active control of flutter induced by stores on the wing of a typical fighter aircraft and its aeroelastic scaling. It is important to note that AASERT grants were provided as research augmentation to a parent grant, and it's sole purpose was to support a domestic Ph.D. student. The total amount of funding in this AASERT grant was $93,413. At the inception of her Ph.D. studies the student, Ms. Anne Le, received a special UCLA Fellowship given to female engineering students, which covered here support for a six months period, thus the funds available from the ASSERT grant were not used during this period. Anne was making satisfactory progress in her research, however she became pregnant and in October 1997 she gave birth to her first child (son) and she took six month of maternity leave (September 97 - February 98), again during this period no expenditures were charged to the grant. Her son was born with an allergy to milk and milk products, and he had a very difficult time during the first year of this life, which required a significant time investment on Anne's part. Anne continued working on her thesis topic, mainly at home and she would spend approximately a day a week at UCLA, so that we could interact on a regular basis.

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FINAL TECHNICAL REPORT FOR THE ACTIVITIES CONDUCTED UNDER AFOSR ASSERT GRANT F49620-95-1-0453 FOR THE PERIOD 7/1/95-6/30/2000

GRANT TITLE: AEROELASTIC PROBLEMS ASSOCIATED WITH EXTERNAL STORES AND INNOVATIVE SCALING LAWS FOR SUCH PROBLEMS

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Introduction and Background

This ASSERT grant was initially funded 7/1/95 and a Ph.D. student (Anne Le) was hired and started her studies towards a Ph.D. degree working on the problem of active control of flutter induced by stores on the wing of a typical fighter aircraft and its aeroelastic scaling. It is important to note that ASSERT grants were provided as research augmentation to a parent grant, and it's sole purpose was to support a domestic Ph.D. student. The total amount of funding in this ASSERT grant was $93,413. At the inception of her Ph.D. studies the student, Ms. Anne Le, received a special UCLA Fellowship given to female engineering students, which covered her support for a six months period, thus the funds available from the ASSERT grant were not used during this period. Anne was making satisfactory progress in her research, however she became pregnant and in October 1997 she gave birth to her first child (son) and she took six month of maternity leave (September 97-February 98), again during this period no expenditures were charged to the grant. Her son was born with an allergy to milk and milk products, and he had a very difficult time during the first year of his life, which required a significant time investment on Anne's part. Anne continued working on her thesis topic, mainly at home and she would spend approximately a day a week at UCLA, so that we could interact on a regular basis.

The main thrust of her research has been the development of an aeroelastic computer code capable of simulating the subsonic flutter of a fighter type wing, including stores (such as missiles or bombs) as well as partial span control surfaces that can be actively controlled and used for flutter suppression. The structural part of the model was based on an equivalent plate type super-element that allows a more efficient representation of the wing structure than conventional finite elements. The principal advantage of the equivalent plate model is computational efficiency. The unsteady aerodynamic model is based on a time domain version of the doublet lattice approach. The frequency domain unsteady aerodynamic loads are transformed into the time domain using Roger's approximation.

After I started in my new position at the University of Michigan (January 1,1999) I spent a week every month at UCLA helping my students complete their dissertations, before my permanent departure from UCLA (July 1, 1999). During this period Anne continued making slow but steady progress working primarily at home. After July 1, 1999 we continued working on her research but most of the communications concerning her thesis research were handled electronically. The funds from the grant continued providing partial support for Anne until June 2000, by that time all the funds were spent. Since then her husband has supported Anne and she is continuing to work, slowly, on her research.

Description of the Ongoing and Completed Research

Anne has generated a draft of a report on her thesis research, which is going to be used as her dissertation prospectus. The prospectus contains a complete description of the work that has been done to date. It also contains an example showing the correlation between her aeroelastic code flutter example problem from the NASTRAN Aeroelasticity Manual, for a typical three-dimensional wing. The results obtained by Anne correlate very well with the results in the NASTRAN manual example. This example was used to validate the analytical tools/codes that she has developed. However, the wing planform, used for the correlation study, is not a proper selection for the wing-store flutter model since it is a swept untapered wing with constant cross-section and solid interior.

Recently, Anne has developed a model for a typical fighter wing that flutters at high subsonic speeds when bearing no external stores. The model is loosely based on the F-16 planform. It has a sweep of 40 degrees and an aspect ratio of 3.45. At sea level, it flutters at Mach 0.75. This is actually a really good bare wing flutter velocity because at M=0.8 and higher, the doublet lattice method can produce somewhat inaccurate results. Currently Anne is adding the external stores to the model. Flutter analysis with the stores should give a flutter velocity lower than the bare wing flutter velocity. Then the task of the flutter suppression device and control system is to bring the flutter velocity (with stores attached) back to the bare wing flutter velocity.

The research described above has been incorporated in a document that will shortly become Anne's thesis prospectus, she expects to advance to candidacy at UCLA before June 1, 2001. There is a good probability that the will complete her research and obtain her degree from UCLA in June 2002.